

## NUTRITION AND THE EYE

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### ABSTRACT

**Objective:** To review ocular pathology associated with poor nutrition and highlight nutrients necessary for healthy eyes

**Method:** Information obtained through review of literature in a pubmed/medline search using the words nutrition, eye, disease; journals, review articles and textbooks.

**Results:** Nutritional deficiencies can lead to ocular diseases such as Xerophthalmia (Vitamin A deficiency) and nutritional optic neuropathy. Poor nutrition has been implicated in the pathogenesis of cataracts and age related macular degeneration. Good nutrition thus helps in preventing and retarding progression of several diseases.

**Conclusion:** It is advisable to pay attention to what we eat and increase our intake of fruits, vegetables and fish for healthy eyes.

**Key words:** nutrition, eye, nutritional deficiency, supplements.

### INTRODUCTION

"You are what you eat" is an adage which underscores the emphasis that has and is still being placed on healthy nutrition. Several studies have shown that foods eaten or not eaten have a profound effect on health<sup>1-4</sup>.

The eye can be regarded as the window for the body as the effect of several systemic diseases can be seen in eye before they have a significant detrimental effect on other parts of the body. These include diabetes, vitamin A deficiency, hypertension and HIV infection to mention a few.

Nutrients are classified as essential or non essential. Non essential nutrients are manufactured in the body and do not need to be obtained from food. Examples include cholesterol which is present in all animal cells<sup>1</sup>. Essential nutrients must be obtained from food sources, because the body either does not produce them or produces them in amounts too small to maintain growth and health. Essential nutrients include water, carbohydrates, proteins, fats, vitamins, and minerals

This article discusses some eye diseases which have been linked with poor nutrition, as well as the nutrients and diet necessary for healthy eyes.

These diseases include vitamin A deficiency, cataracts, age related macular degeneration and dry eyes. Some nutrients have also been found helpful in the treatment of glaucoma and diabetic retinopathy<sup>5</sup>.

## XEROPHTHALMIA

Vitamin A is essential for the synthesis of retinal photopigment-rhodopsin and conjunctival glycoproteins<sup>6</sup>. It is essential for immunity as well as maintenance of health of mucous membranes<sup>7</sup>. Deficiency also leads to susceptibility to respiratory, intestinal and genitourinary infections. The retinal pigment epithelium plays a major role in the metabolism and storage of Vitamin A and is second only to the liver in the concentration of Vitamin A<sup>6</sup>.

Xerophthalmia is a spectrum of ocular disease caused by vitamin A deficiency and is responsible for 100,000 new cases of blindness worldwide each year especially in developing countries<sup>8</sup>. Vitamin A deficiency (VAD) is the commonest single cause of blindness in children, accounting for an estimated 350,000 new cases each year<sup>9</sup>. Vitamin A deficiency is also very important as it is associated with higher infant and childhood mortality rates, particularly associated with measles. While vitamin A deficiency can occur at any age, the group at risk of blindness is children in the preschool age group, from 6 months to 6 years of age especially if their mothers had VAD in pregnancy or during breastfeeding<sup>9</sup>.

Vitamin A deficiency can occur for three major reasons:

- Reduced intake of foods rich in vitamin A
- Poor intestinal absorption of vitamin A, usually because of diarrhoea
- Increased need for vitamin A, as occurs during infections, especially measles, herpes simplex, malaria.

## WHO GRADING OF XEROPHTHALMIA (Table I)

Clinical features include night blindness (nyctalopia), ocular irritation due to dryness and Bitot spots which are triangular patches of keratinized epithelium in the palpebral zone associated with infection by *Corynebacterium xerosis*<sup>8</sup>. There is a loss of goblet cells of the conjunctiva with squamous metaplasia and keratinization. The cornea has a lustreless appearance due to dryness, punctate epithelial erosions which can progress to corneal ulceration<sup>8</sup>. Sterile melting by liquefactive necrosis-keratomalacia may result in perforation of the globe and blindness. The onset is often sudden, as the cornea may melt very quickly, even over a few hours<sup>10,11</sup>. The significant end stage of malnutrition causing eye damage, in a child who survives, is corneal scarring. Corneal scarring often has a marked effect on vision. The anterior part of the eye may bulge forward (anterior staphyloma)<sup>10</sup>.

**Table I: WHO GRADING OF XEROPHTHALMIA<sup>35</sup>**

<b>XN</b>	<b>Night blindness</b>
<b>X1A</b>	Conjunctival xerosis
	X1B with Bitot's spot
<b>X2</b>	Corneal xerosis
<b>X3A</b>	Corneal ulceration affecting less than 1/3 corneal surface
<b>X3B</b>	Corneal ulceration/Keratomalacia affecting more than 1/3 corneal surface
<b>XS</b>	Corneal scar due to xerophthalmia
<b>XF</b>	Xerophthalmic Fundus

## TREATMENT

Recommended dosages of vitamin A as seen in **Table 2**

Pregnant women with VAD should have 10,000 I.U of vitamin A as large doses are teratogenic. After giving birth they can be treated with 300,000 I.U. Vitamin A days 1, 2 and 8 to ensure a good supply of vitamin A in breast milk<sup>1,8,10</sup>.

Intense lubrication with artificial tears and antibiotic ointments and topical retinol to promote healing are helpful.

The child may need corneal transplant (keratoplasty) to treat perforation or corneal scar<sup>8</sup>.

Foods which are rich in vitamin A include palm oil, liver, milk; dark green leafy vegetables, spinach, sweet potatoes, peppers and coloured fruits like pawpaw, mango, carrots contain beta carotene which is a source of vitamin A. They should not be overcooked or sun dried<sup>11</sup>.

**Table II: THE RECOMMENDED DOSES OF VITAMIN A<sup>36</sup>**

Emergency Treatment of Xerophthalmia		Dose by mouth iu	Dose by mouth mg	
	Day 1	200,000	110	Children <1yr or 8kg should have half dose
	Day 2	200,000	110	
	Day 14	200,000	110	
<b>Preventive treatment</b>				
	Children <1yr	100,000	55	Repeat every 4-6 months
	Children >1yr	200,000	110	Repeat every 4-6 months
	Children at birth	50,000	27.5	
	Mothers just giving birth	300,000	165	
	Pregnant and lactating mothers	10,000	5.5	Daily for 2 weeks

## CATARACTS

The Nigerian blindness survey conducted between 2004 and 2007 revealed that prevalence of blindness for all ages in Nigeria is 0.78% while prevalence in adults 40 and above is 4.2%. The most common cause of blindness in Nigeria is cataract which accounts for 42.9%<sup>12</sup>.

A cataract is an opacification of the crystalline lens. The lens is a biconvex

avascular transparent structure enclosed by a capsule which helps to bend light rays and focus them on the retina. The lens is made up of several proteins called crystallins, lipids and cytoskeletal elements precisely arranged to maintain transparency. However with time oxidation of side chains, glycation, phosphorylation, carbamylation occur causing

crosslinking, protein aggregation and increase in pigmentation. These processes cause a loss of transparency and cataract<sup>13</sup>.

There are several factors that we cannot control that may increase the risk of developing cataracts like increasing age, family history and sex<sup>14</sup>. Others however are modifiable for example not smoking, reducing exposure to sunlight by wearing protective eyewear which has filters for ultraviolet (UV) A/B rays and wide brimmed hats, controlling other diseases such as diabetes and eating a healthy diet<sup>15</sup>.

Higher intake of carbohydrates and higher dietary glycemic index (dGI) were associated with higher incidence of nuclear and cortical cataracts<sup>16</sup>.

The lens has a natural antioxidant called glutathione. Studies have shown antioxidants have a significant role in preventing and are also thought to slow the progression of cataracts<sup>17,18</sup>. These include vitamins C, E, carotenoids such as lutein and zeaxanthin. The five year follow up to the Beaver Dam Eye Study showed a reduced risk for nuclear and cortical cataracts among people using multivitamins or any supplement containing vitamins C and E<sup>17</sup>. Those with the highest intake of lutein and zeaxanthin had significantly lower risk of developing cataracts<sup>17,18</sup>. Lutein and zeaxanthin are pigments found within the eye in the lens, retina and macula. They help to prevent the effects of UV radiation.

Good sources for vitamin E include almonds, peanuts, corn oil and sunflower seeds while good sources of vitamin C include oranges, grapefruit, tangerines, pawpaw, green pepper, tomatoes.

Dark green leafy vegetables are the primary source of lutein and zeaxanthin, but they are also present in lesser amounts in other coloured

fruits and vegetables, such as broccoli, orange peppers, corn, peas, and tangerines.

People taking vitamin C supplements for more than 10 years had a 45-77% lower risk of early lens opacities (cataracts) and 83% lower risk of moderate lens opacities. The higher the serum levels of vitamin C, the lower the risk of cataracts<sup>19</sup>. Dietary intake of protein, vitamins A, C, E, and carotene, niacin, riboflavin, and thiamine have been found to significantly decrease the risk of all types of cataract<sup>20,21</sup>.

Glutathione (found in asparagus) has been found to be beneficial in delaying progression of cataracts.

## AGE RELATED MACULAR DEGENERATION

This is the most common cause of irreversible blindness in the developed world in people above 50 years of age<sup>8</sup>. Age related maculopathy is like an exaggeration of the ageing process and is characterised by discrete yellow spot (drusen) at the macula and hyper or hypo pigmentation of the retinal pigment epithelium<sup>8</sup>.

Age related macular degeneration (AMD) is more advanced and sight threatening with geographic atrophy, pigment epithelial detachment (PED), subretinal or retinal pigment epithelium (RPE) haemorrhage and exudates, choroidal neovascularisation and fibroglial scar tissue. Results from the Age related Eye Disease study (AREDS) showed that a combination of high levels of antioxidant vitamins A, C and E (in combination with the mineral zinc) significantly reduces the risk of advanced macular degeneration and its associated visual loss<sup>23</sup>.

Recommended doses are<sup>22-24</sup>

- Vitamin C – 500 mg
- Vitamin E - 400 IU
- Vitamin A (as beta-carotene) - 15 mg

- Zinc (as zinc oxide) - 80 mg
- Copper (as cupric oxide) - 2 mg
- Lutein is also found to be protective. People who had diets rich in green leafy vegetables had reduced risk of developing AMD<sup>25</sup>.

Consumption of a diet rich in docosahexaenoic acid (DHA) was associated with lower progression of early AMD. In addition to the AREDS recommended supplement, lower dGI with higher intakes of DHA and eicosapentaenoic acid (EPA), was associated with reduced progression to advanced AMD<sup>22</sup>. These omega 3 fatty acids are also helpful in treatment of dry eyes and prevention of cataracts.

People who smoke should not take supplements containing beta carotene as this has been associated with a higher risk of lung cancer. Natural sources of Beta carotene do not seem to confer increased risk<sup>24</sup>.

### GLAUCOMA

Glaucoma is a group of optic neuropathies with a characteristic optic nerve head cupping and visual field defects with raised intraocular pressure as a major risk factor. The role of nutritional supplements in glaucoma is still being debated. While intraocular pressure is the major modifiable risk factor, some patients have glaucoma progression despite statistically normal intraocular pressures. Some studies have shown that vitamins E, C, B12, glutathione, alpha lipoic acid, magnesium, thiamine, ginkgo biloba (a plant extract) have a neuroprotective effect and are helpful in the treatment of glaucoma<sup>5,26-28</sup>.

### TOXIC/NUTRITIONAL OPTIC NEUROPATHY

Some substances taken into the body can act as exogenous poisons which

damage the optic nerve leading to loss of vision. These include heavy alcohol intake, cigarette and tobacco pipe smoking. They act synergistically hence the name Tobacco-Alcohol Amblyopia.

Chronic alcoholics derive calories from breakdown of alcohol, thus neglecting their diet and developing deficiency of proteins and B complex vitamins which are vital to the health of the optic nerve. Cheap adulterated alcohol (local gin-“Ogogoro”) has a high content of methyl alcohol which is oxidised in the body to formic acid and formaldehyde which are toxic to the optic nerve<sup>30</sup>.

Some species of cassava have high content of cyanide. If these are processed in a hurry into garri or fufu without removal of the cyanide can lead to optic nerve damage<sup>29</sup>.

Vitamin B complex deficiency can lead to optic atrophy through demyelination of the nerves<sup>30</sup>.

Treatment includes cessation of alcohol intake, cigarette smoking and parenteral injections of hydroxocobalamin (vitamin B12) weekly. Foods rich in vitamin B complex include meat, liver, yeast, eggs, potatoes, milk, peanut, beans, cereals like corn and millet.

### DIABETES

Compliance to prescribed diet and good glycemic control is important in diabetics. This helps to reduce the progression of diabetic retinopathy and cataracts<sup>31,32</sup>.

Zeaxanthin reduces retinal oxidative damage and production of vascular endothelial growth factor (VEGF)<sup>33</sup> which is implicated in diabetic retinopathy. Other experimental supplements for diabetic eyes include chromium, high dose vitamin E, magnesium and taurine<sup>34</sup>.

## OBESITY

Although obesity does not appear to have direct effects on the eye, it is associated with conditions which can adversely affect the eye. Obesity is associated with hypertension, dyslipidemia and impaired glucose tolerance. These conditions can cause central retinal vein occlusion, central retinal artery occlusion, anterior ischemic optic neuropathy<sup>37</sup>. It is also associated with benign intracranial hypertension which causes papilloedema and can lead to secondary optic atrophy<sup>38</sup>. Vitamin C is helpful in laying down of collagen and healing of the cornea and sclera.

## CONCLUSION

In a nutshell a healthy diet for the eyes includes

- **Vitamin A:** cod liver oil, liver, carrots, sweet potatoes, palm oil.
- **Lutein and zeaxanthin:** dark green vegetables, egg yolk, corn, mango.
- spinach, kale, lettuce,
- **Vitamin C:** oranges, sweet peppers (red or green), kale, strawberries, broccoli, citrus fruits, tomatoes, cherries, grapes.
- **Vitamin E:** peanuts, almonds, hazelnuts, sunflower seeds.
- **Selenium (an antioxidant):** yeast, seafood.
- **Zinc:** oysters, wheat, nuts.

**Omega 3 Fatty acids:** cold-water fish (salmon, mackerel, trout]

It is recommended that we take five servings of fruits and vegetables every day, two servings of nuts every day and to eat fish at least two days a week for healthy eyes.

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